PATENT SPECIFICATION

772,690

Date of Application and filing Complete Specification March 14, 1955

No. 7393/55.

Application made in United States of America on March 12, 1954.

Complete Specification Published April 17, 1957.

Index at acceptance :—Class 135, VJ3.

International Classification : —F06k.

COMPLETE SPECIFICATION

Improvements in or relating to Check and Foot Valves

We, AMES IRRIGATION PTY. LIMITED, of 60, Hunter Street, Sydney, New South Wales, Australia, a Company incorporated under the laws of the State of New South Wales, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to check and foot valves generally and has for its particular object to provide a novel check or foot valve that shall offer a minimum of resistance to fluid flow through the valve, yet which shall act positively to close the valve just before a column of liquid moving through the valve can stop and reverse its direction of flow.

It is customary in the transportation of liquids to use both check and foot valves to seal off a head of liquid within the system, so that the column will be retained and not lost by drainage when movement of the liquid ceases. A familiar example is the use of either a check or foot valve to hold a column of liquid within a pump by sealing off the pump's discharge or intake ends, respectively, so that the pump remains primed during periods of non-use. In such use it is particularly important that the foot or check valve provides an absolute seal so that there is no liquid drainage or leakage of air which will destroy the priming, particularly if the valve is to be used in connection with a primer, such as an exhaust or suction primer. Previous valves give inadequate leak-tight seals, close too slowly or violently, have excessive friction drag and pressure drop and cause "water hammer".

Our invention comprises a spring loaded toggle-action swinging valve which closes just prior to reversal of fluid flow. It embodies a valve-closing toggle linkage which operates by pressure applied on a knee joint of the linkage to multiply the closing pressure on the valve in its closed position, but which also operates by a reverse linkage to substantially reduce the pressure tending to close the valve in an open position, so that a minimum of pressure is required to maintain the valve in its open position.

Another object of the invention is to provide a toggle linkage which shall assume a relatively flat obtuse angle in the closed position of the valve, whereby a minimum spring load is required to maintain a leak-tight valve seal, and which shall assume a relatively pointed acute angle in the valve-open position, the increased spring load nevertheless not producing a valve-closing force as great as that produced by the spring in the closed position of the valve.

The invention is defined in the appended claims and an example is illustrated in the accompanying drawings.

Figures 1, 2, 3 and 5 show the valve closed, Figures 4 and 6 open, Figures 5 and 6 being diagrammatic to illustrate relations of spring pressure to actual valve closing pressure.

Referring to the drawings in detail, A indicates a valve body which may include a generally cylindrical shell portion 9 tapering to reduce end portions 10 and 11 adapted for welding to suitable couplings, which are not shown. Rigidly secured in the end 10 as by welding, is the valve seat B which extends inwardly into the valve body A. Preferably, the valve seat is provided with an annular, curled flange 15 on its inner edge. Adapted to engage the flange 15 of the valve seat B in a sealing relation is the valve or clapper C. The valve C may take any conventional form, but is illustrated as a circular metal disc 12 faced by a sealing disc 13 which may be fabricated of a suitable resilient, compressible material, such as rubber, so that a leak-tight seal will be provided when the valve A is pressed firmly into contact with the valve seat B.

Rigidly secured to the shell 9 of the valve body, by cap screws 16, is the mounting channel M. The hinge blade member D is pivotally supported from the channel M by a hinge pin 17 extending outwardly through circular bearing holes 18 in the sides 19 of the mounting channel M. Preferably the hinge blade D is also channel-shaped and has elongated perforations in its ears 20 through which pass the extending ends of the hinge pin 17. Annular grooves 17a near the ends of the pins 17

receive the looped ends 30 of the springs G and hold the pin 17 in place. The elongated perforations 28 in the blade D allow the valve clapper C to seat itself evenly on the valve seat 15 under influence of the pressure applied by the toggle linkage E.

The valve C is rigidly secured to a cross portion 21 of hinge member D, as by rivets 22, and, consequently, moves with the hinge member D to open and closed positions of the valve C relative to the valve seat B, as will be described.

It will be clear that the structure just described constitutes within itself a check or foot valve permitting flow in one direction, but preventing flow in the opposite direction. This flow is from left to right as viewed in Figures 3 to 6 of the drawings. However, a particular feature of the present invention resides in the unique valve-closing action provided by the toggle linkage E. This linkage is provided by the links F, F¹ and the spiral coil springs G. Each of the links F, F¹ is a channel member having elongated sides apertured at both ends. The upper link F is supported by a pin 23 extending through apertures in the mounting bracket M. Endwise movement of the pin 23 may be prevented by cotter pins 24 in well-known manner. The lower link F¹ is pivotally secured to the hinged valve structure by a pin 25 supported in the lower end of the hinge member D. Cotter pins 26 may also be provided in the ends of the pin 25, as before. The two links F, F¹ are pivotally connected at a common joint provided by a knee pin 27, secured against endwise movement by the ends of the springs which engage in annular grooves 27*a* cut near the ends of the pin 27. Tension is applied to the knee joint 27 by means of the extended springs G.

Figures 3 and 5 illustrate the operation of the toggle mechanism E when the valve is in a closed position. As shown, the links F, F¹ form a relatively flat obtuse angle ϕ. As a result a comparatively small force effectively applied at the common joint 27 and acting in a direction tending to straighten out the links is capable of exerting a large pressure at the moving end, which in the present application is the end secured to the valve clapper. This feature is diagrammatically illustrated in Figure 5 where the relatively small tension exerted by the springs G is represented by the letter P, while the resulting much larger pressure exerted by the toggle linkage E is represented by R_1, while R_2 represents the ultimate closing pressure exerted on the valve clapper C. Due to this multiplication of pressures, the valve C is firmly urged against the valve seat B and through compression of the rubber valve face 13 a gasketing effect is achieved that ensures an absolutely leak-tight seal.

The operation of the toggle linkage E in the open position of the valve is illustrated in Figures 4 and 6. In this position the valve has been pushed open and is being held open by liquid flow through the valve, indicated by the flow arrow at the left of Figure 6. As a result, the toggle linkage E has assumed the relatively pointed acute angle designated by O. However, by a reverse linkage inherent in the toggle action, a comparatively large pressure in a direction tending to straighten out the linkage will produce only a relatively small pressure at the moving end of the linkage secured to the valve clapper C. This principle is diagrammatically illustrated in Figure 6, where the increased pressure P exerted by the springs G, under considerable extension, produces only a small resulting force R_1 which produces an even smaller valve closing pressure R_2. The ultimate effect of this reverse linkage is a relatively small pressure loss across the valve due to so much less energy being required to hold the valve open than that required in the first instance to swing it open. This feature is particularly important in forced circulation systems utilising the pump, since only a relatively small portion of the pump's energy must be diverted to the task of holding the valve open once it has been opened. This results in maximum pumping efficiency in the system. It also gives another important operating characteristic, namely, that as soon as the fluid flow has almost ceased, the clapper C will immediately begin to close and, while there is still a slight flow, the clapper C will close on its seat 15. This assures that a full column of fluid will be trapped in the pipe and, more important, it prevents any possibility of water hammer. Also, portions of the sides 19 of the mounting bracket M may be cut away, as at 34, to facilitate a free, full opening movement of the valve C.

What we claim is:—

1. A valve particularly adapted for use as a check or foot valve comprising a valve body, a valve seat in said body, a swinging valve member adapted to close against said valve seat in a leak-tight manner, and spring-load toggle means arranged to urge said valve member towards its closed position relative to said valve seat and so constructed and arranged as to produce a reverse linkage effect, whereby said toggle means will exert a maximum closing force when said valve is in its closed position and a minimum closing force when said valve is in its open position.

2. The device claimed in Claim 1 wherein said toggle means comprises at least one pair of links connecting said valve member to said valve body, said links being pivotally connected together by a common joint so positioned within the valve body that the said links form an obtuse angle with each other when the said valve member is in its closed position and an acute angle with each other when the said valve member is in its open position.

3. The device claimed in Claim 2 wherein resilient means connect the or each of said common joints to the valve body in such manner that said resilient means act in a direction tending to align said links with one another in both the open and closed positions of the valve member.

4. A check or foot valve adapted to close just before reversal of fluid flow through the valve, such fluid flow normally acting to hold the valve open, comprising a valve body having a valve seat, a valve member adapted to engage said seat in a leak-tight relation and a spring-loaded toggle means to actuate said valve, including a first link member connected to said valve member, a second link member connected to said valve body, a common joint pivotally connecting said links, and spring means connecting said common joint to said body; the relative positioning of the said respective parts of the toggle means being such that in a closed-valve position the link members form a relatively flat obtuse angle, while in an open-valve position said link members form a relatively pointed acute angle; whereby in said closed-valve position a relatively small spring force applied in a direction tending to straighten out said links will result in a valve-closing force much larger than said spring force, while in said open-valve position a relatively large spring force tending to straighten out said links will result in a valve-closing force much smaller than either of said aforementioned spring forces.

5. A check or foot valve particularly adapted to provide a minimum of pressure drop across the valve during operation and to prevent damage due to slow valve closure, comprising a valve body; a valve seat in said valve body; a valve member adapted to engage said valve seat in a leak-tight manner; hinge means mounting said valve on the valve body for movement between open and closed positions and toggle means linking said valve to said valve body to supply closing pressure to said valve, including a knee joint and resilient means connecting said knee joint to the valve body; whereby said toggle means will exert a maximum valve-closing force when said valve is in said closed position and a minimum valve-closing force when said valve-closing force when said valve is in said open position.

6. The valve of Claim 5 in which said resilient means is a tension spring means acting to straighten out said toggle means.

7. A check or foot valve offering a minimum of resistance to fluid flow through the valve comprising a valve body; a valve seat in said valve body; a valve member adapted to close against said valve seat in a leak-tight manner; hinge means mounting said valve on the valve body for movement between open and closed positions, and toggle means linking said valve member to said valve body to supply closing pressure to said valve, including a first link connected to said valve member, a second link connected to said valve body; a common joint pivotally connecting said links; and spring means connecting said common joint to said valve body, the relative positioning of said respective parts being such that in a closed valve position the link members form a relatively flat obtuse angle, and in an open valve position said link members form a relatively pointed acute angle; the said spring means being arranged to act in a direction to tend to align the two said links with one another.

8. A spring-loaded check or foot valve providing a leak-tight valve seal at relatively low loading or spring pressures and offering a minimum of frictional resistance to fluid flow therethrough when the volume of flow is sufficient substantially to open the valve, comprising a valve body having a seat, a valve member adapted to seal against said seat, hinge means on said valve body mounting said valve member for movement between open and closed positions relative to said valve seat, and closure means for said valve member including a toggle linkage connected between the valve member and valve body and pressure-applying means operable on a knee joint of said toggle linkage tending to straighten it out, said toggle linkage assuming a relatively flat obtuse angle in a closed-valve position and a relatively pointed acute angle in an open position, whereby said closure means will exert a maximum closing pressure in a closed position and a minimum closing force in an open position, thereby permitting a leak-tight closure while insuring a minimum pressure drop across the valve during operation.

9. The valve of Claim 8 in which said pressure-applying means is a tension spring positioned within the angle formed by said toggle linkage and connected at one end to said knee joint and at its other end to the valve body.

10. A check or foot valve substantially as illustrated in the accompanying drawings and substantially as hereinbefore described by reference thereto.

MARKS & CLERK.

Leamington Spa: Printed for Her Majesty's Stationery Office, by the Courier Press.—1957.
Published at the Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies may be obtained.

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3 SHEETS

This drawing is a reproduction of the Originol on a reduced scale.
SHEET 1

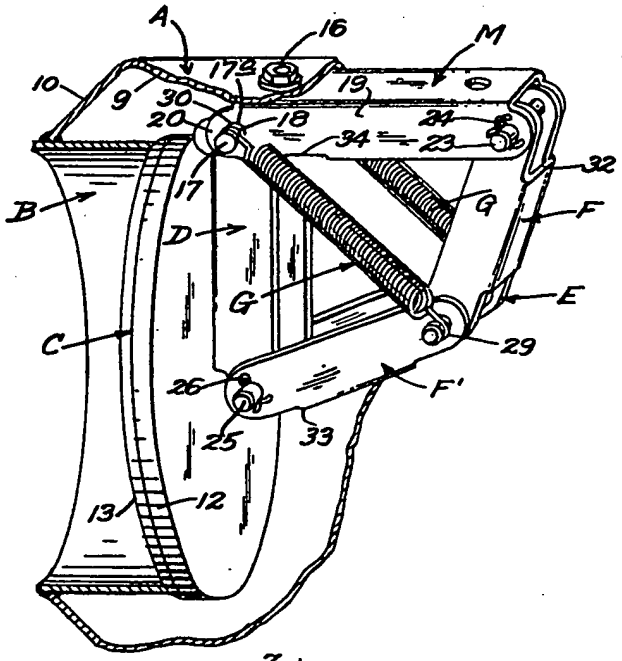

Fig. 1.

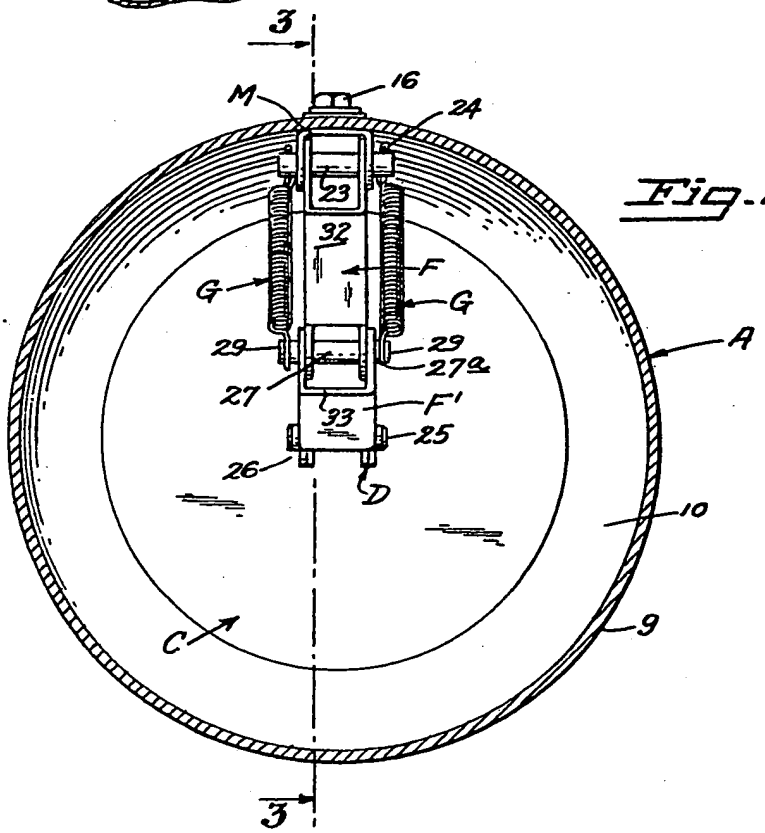

Fig. 2.

Fig. 3.

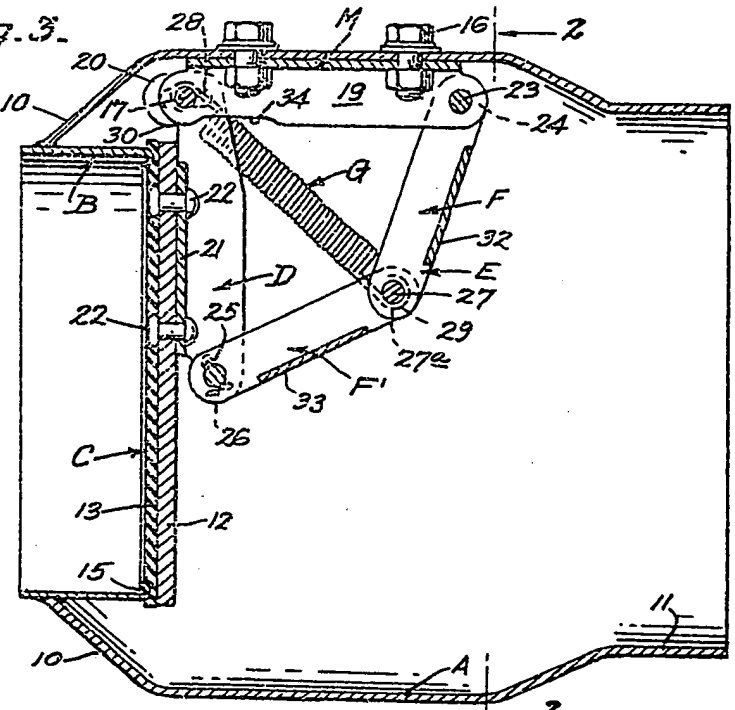
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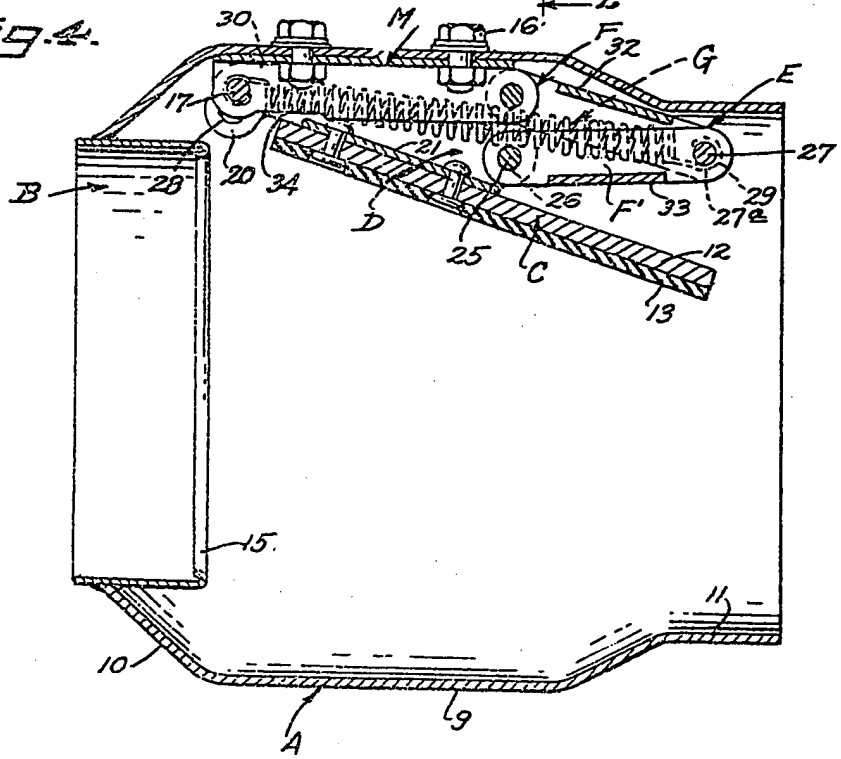
Fig. 4.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3 SHEETS
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SHEETS 2 & 3

Fig. 5.

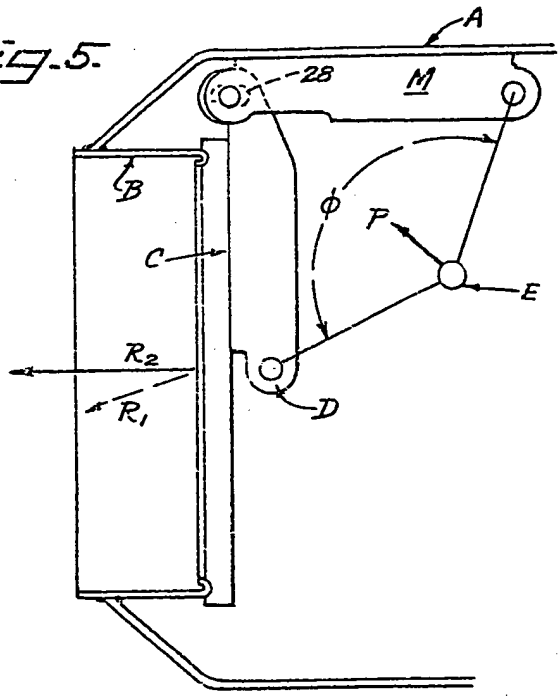
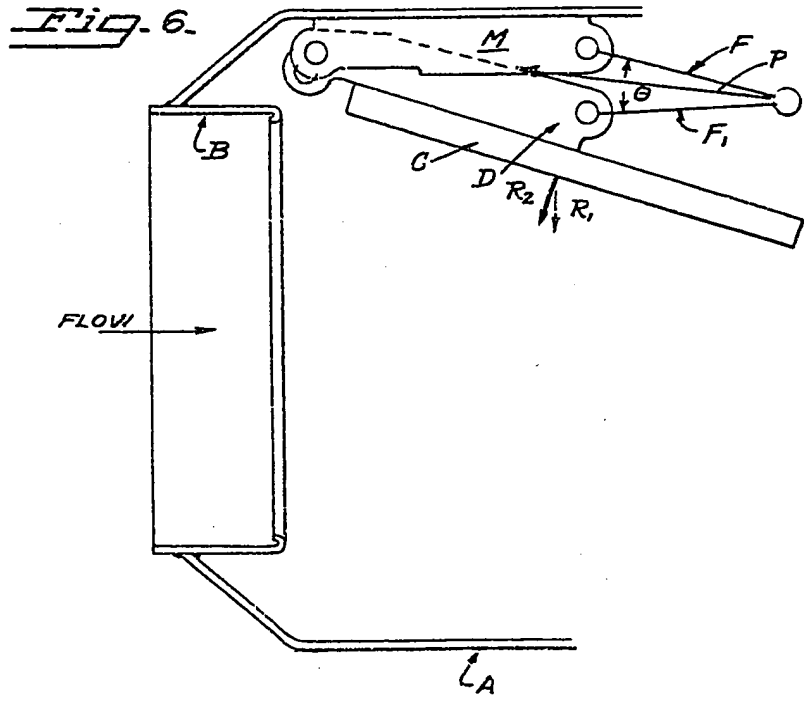


Fig. 6.



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3 SHEETS

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SHEETS 2 & 3

Fig. 3.

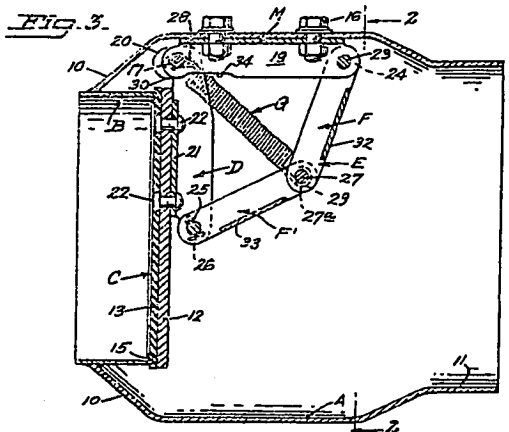

Fig. 4.

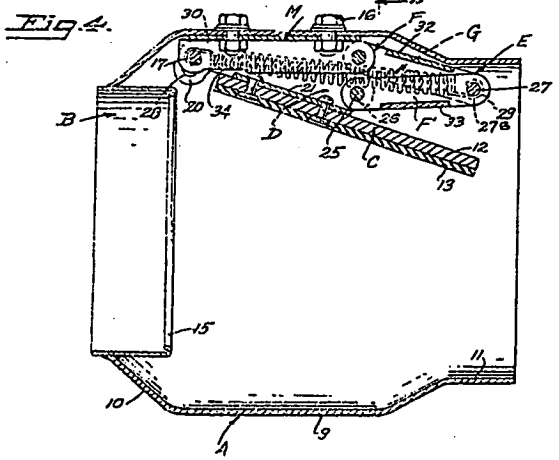

Fig. 5.

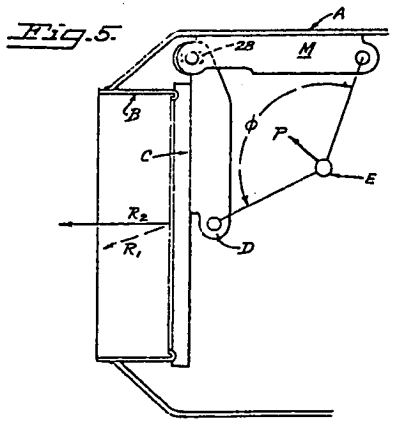

Fig. 6.